PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Electroluminescent Lamp

We, SYLVANIA ELECTRIC PRODUCTS INC., a corporation organised under the laws of the State of Massachusetts, United States of America, of 60, Boston Street, Salem, Massachusetts, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electroluminescent lamps.

It has been proposed to provide an electroluminescent lamp which comprises silicon or other carbide crystals mounted on a sheet of reflecting material, which may also serve as the anode of the lamp, the crystals being retained on the sheet by an electrical insulating and protecting coating of aluminium oxide (when the sheet is of aluminium), or by a layer of vitreous enamel, or by applying the crystals under heat and pressure when the sheet is of a thermoplastic material. A suitable cathode is of open mesh gauze and is mounted over the crystal faced anode plate. The cathode sheet may also be embedded in a sheet of plastic material.

It has also been proposed to provide such a lamp comprising a layer of carborundum crystals free of iron mounted on an anode in a container. The container wall facing the crystal layer is of glass. An annular cathode is disposed in the space between the crystal layer and the glass wall and the interior of the container is filled with a liquid electrolyte. The lamp may also comprise a layer of crystals sandwiched between two thin wire nets, which are in turn sandwiched between two glass plates. The thin wire nets may be replaced by thin transparent layers of metal on the glass plates and it is proposed that solder be used on the crystals to ensure good contact between them and the lamp electrodes.

An object of this invention is to provide an electroluminescent lamp of new form.

According to this invention there is provided an electroluminescent lamp comprising a support of an insulating material, a pair of spaced conductive electrodes mounted side by side on the support, and a phosphor which is excited to luminescence by an electric field disposed between the electrodes to be permeated by an electric field produced between the electrodes. The phosphor may be embedded in a dielectric material. Each electrode may have a coating of dielectric material between itself and the phosphor.

Each of the electrodes may be very long in comparison with its width and/or thickness. The electrodes may be parallel wires wound on the support or they may be intermesherl spaced grids fixed on the support.

A feature of the invention is the use of a phosphor containing a small amount of halogen, for example chloride, and other features are, for example, the use of a zinc sulphide phosphor, preferably activated, sensitised or the like by the addition of small amounts of copper and lead, and larger amounts of zinc oxide.

Examples of the invention will be described with reference to the accompanying drawings in which:—

Fig. 1 is a perspective view of a lamp according to the invention;

Fig. 2 is a section, to a larger scale, of another form of lamp similar to that shown in Fig. 1;

Fig. 3 is a plan view of a further form of lamp according to the invention, and

Fig. 4 is a section on the line 4—4 in Fig. 3.

In Fig. 1 a support tube or rod of an insulating material 10, for example a tube or rod of glass, has wound thereon a pair of spaced wires 11, 12, the wires being close together and side by side, in the form of a two start helix. A coating 18 of dielectric material, e.g. an insulating enamel, may be present on each wire to reduce the possibility of flashover between wires, although this may be omitted if dielectric material is provided in the coating of phosphor, as hereinafter explained.

In the form of lamp shown in Figure 2 the wires 11 and 12 are mounted on a flat plate 19 of insulating material, instead of the rod or tube 10.

A coating 15 of a finely powdered material that is excited to luminescence by an electric

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field, herein generally called a phosphor, is applied over and between the wires. The phosphor coating may be, for example, but not by way of limitation, a composition of zinc oxide and zinc sulphide activated with small quantities of halogen, copper and lead.

In Figs. 3 and 4 two intermeshed metallic grids 16, 17 are printed side by side on an insulating support plate 19, for example of glass, or they may be deposited by sputtering, electro-deposition or the like, or in any convenient manner. A thin coating of dielectric material may be placed over the metal, and the phosphor layer 15 then added.

The spacing between the wires 11 and 12 or the grids 16 and 17 is exaggerated in Figs. 1 to 4 for greater clarity, and should generally be quite small, e.g. of the order of a few thousandths of an inch. With round wires, as in Fig. 2, coated with insulation 18, the insulating layers may be permitted to touch.

In modifications of the lamps shown in Figs. 1 to 4, a material of high dielectric constant, dielectric strength, and resistivity is used to fill the pores or spaces in the phosphor coating. The filling of the pores or spaces between particles in the coating by a dielectric material such as described reduces the danger of flash-over of the applied voltage through these pores or spaces. Suitable dielectric materials are synthetic resins such as nitrocellulose, polyvinyl chloride, polyethylacrylate and the like. The dielectric and embedded phosphor may form layers of 0.005 inch thickness or even less, for example, the thickness of a single layer of phosphor particles.

In some cases, the phosphor itself may be an organic material such as petroleum jelly, often called petrolatum, or a similar mixture of hydrocarbons. Other organic luminescent materials such as anthracene, phenanthrene or the like may be used as phosphors. When an organic phosphor is used, it will generally need to be placed in intimate contact with the conductors.

Inorganic phosphors will usually be preferable, and the presence of a trace of halogen will generally enhance their brilliance. A suitable phosphor may be prepared by mixing about 75% of zinc sulphide and 25% of zinc oxide by weight, with about 0.001% to 1% of halide, for example, and about 0.00001% to 0.005% of a suitable copper compound, for example, copper sulphate and about 0.1% or less to about 5% of a suitable lead compound such as lead sulphate.

The phosphor components may be thoroughly mixed in the form of fine powders, then heated to between about 900° C. and 1250° C. in an inert, preferably static atmosphere, for example in a gas-tight electric furnace filled with nitrogen, and having a chamber of nitrogen at atmospheric pressure connected thereto.

Zinc sulphide luminesces more brightly under excitation of the type described here, when combined with zinc oxide. Zinc oxide of itself appears to luminesce but much more dimly than when combined with sulphide. The phosphor will luminesce with only the halide activator, but more brightly with the addition of copper, and still more brightly with the addition of both copper and lead. The zinc sulphide and oxide may also be combined with similar cadmium compounds.

The halide may be added, for example, as a chloride or bromide, and may be added in the form of the respective hydrogen acid, ammonium, zinc or cadmium halide, alkali halide, or even organic halides.

The metal activators may be suitable metal salts, for example, the nitrates or sulphates. The zinc sulphide and oxide may be formed by precipitation and the activator added at that time or later to a suspension of the base material which is later dried.

The mixture may be fired in closed or open containers, in the presence of air or in vacuum, or preferably in an atmosphere of an inert gas or nitrogen as previously described. A temperature range of about 900° C. to 1250° C. is satisfactory, but is not critical.

What we claim is:—

1. An electroluminescent lamp comprising a support of an insulating material, a pair of spaced conductive electrodes mounted side by side on the support, and a phosphor which is excited to luminescence by an electric field disposed between the electrodes to be permeated by an electric field produced between the electrodes.

2. A lamp as claimed in claim 1, wherein the phosphor is embedded in dielectric material.

3. A lamp as claimed in claim 1, wherein each electrode has a coating of dielectric material between itself and the phosphor.

4. A lamp as claimed in any one of claims 1 to 3, wherein each of the electrodes is very long in comparison with its width and/or thickness.

5. A lamp as claimed in any one of claims 1 to 4, wherein the electrodes are parallel wires mounted on the support.

6. A lamp as claimed in any one of claims 1 to 4, wherein the electrodes are intermeshed, spaced grids fixed on the support.

7. A lamp as claimed in any one of claims 1 to 6, wherein the spacing of the two electrodes from one another is of the order of a few thousandths of an inch.

8. A lamp as claimed in any of claims 1 to 7, wherein the phosphor contains a small amount of halogen.

9. A lamp as claimed in claim 8, wherein the phosphor consists of or includes a fired mixture of zinc sulphide and zinc oxide, with a trace of halogen.

10. A lamp as claimed in claim 9, wherein the phosphor consists of or includes a fired

mixture of zinc sulphide and zinc oxide, with traces of halogen and copper.

11. A lamp as claimed in claim 8, wherein the phosphor consists of or includes a fired mixture of zinc sulphide and zinc oxide, with traces of halogen and copper, and a small amount of lead.

12. A lamp as claimed in claim 11, wherein the phosphor consists of or includes a fired mixture of about 75% by weight of zinc sulphide, about 25% by weight of zinc oxide, traces of halogen and copper and between about 0.01% and 5% by weight of a lead compound.

13. A lamp as claimed in any of claims 1 to 7, wherein the phosphor consists of or includes zinc oxide, copper and lead.

14. A lamp as claimed in claim 13, wherein the phosphor includes zinc sulphide.

15. A lamp as claimed in claim 13 or 14, wherein the phosphor includes cadmium oxide.

16. A lamp as claimed in claim 13, 14 or 15, wherein the phosphor includes cadmium sulphide.

17. A lamp as hereinbefore described with reference to and shown in Fig. 1 of the accompanying drawing.

18. A lamp as hereinbefore described with reference to and shown in Fig. 2 of the accompanying drawing.

19. A lamp as hereinbefore described with reference to and shown in Figs. 3 and 4 of the accompanying drawing.

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735,752 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

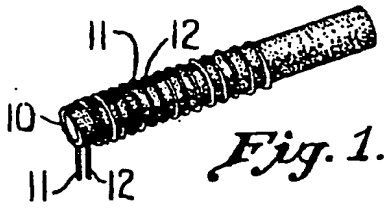

Fig. 1.

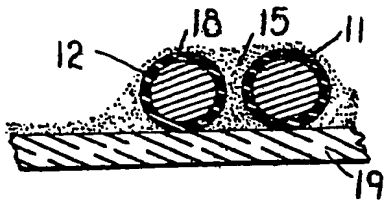

Fig. 2.

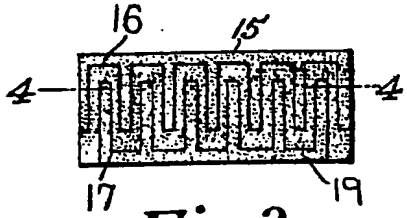

Fig. 3.

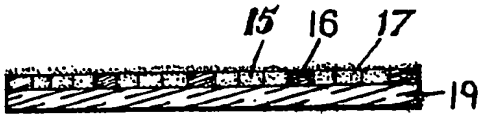

Fig. 4.